PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0010]

Patent Document 1: JP 11-57739 A

Patent Document 2: JP 8-117747 A

Patent Document 3: JP 10-15307 A

Patent Document 4: JP 2004-330034 A

Patent Document 5: JP 2005-125152 A

Patent Document 6: JP 2008-68200 A

Patent Document 7: JP 2009-248028 A

Patent Document 8: JP 2009-255062 A

Patent Document 9: JP 2010-12362 A

Patent Document 10: JP 2001-70758 A

Patent Document 11: JP 2002-336871 A

Patent Document 12: JP 2008-168199 A

Patent Document 13: JP 2009-226285 A

Patent Document 14: JP 2010-201335 A

Patent Document 15: JP 2011-161304 A

SUMMARY

PROBLEMS TO BE SOLVED

[0011]

An object of the embodiments disclosed herein is to provide a water treatment method in which impurities such as suspended substances in raw water are efficiently removed using a separation membrane, and in particular clarified water with

sufficiently high water quality is stably produced as supplied water of a reverse osmosis membrane unit using a microfiltration membrane or an ultrafiltration membrane.

SOLUTIONS TO THE PROBLEMS

[0012]

In order to solve the problems, the present invention includes the following embodiments.

[0013]

A water treatment method includes

dosing a cationic coagulant to raw water to form primary coagulated water,

using the primary coagulated water as it is as final coagulated water when the zeta potential of the primary coagulated water is less than 0 mV, or using final coagulated water obtained by dosing an anionic substance so that the zeta potential is less than 0 mV when the zeta potential of the primary coagulated water is 0 mV or more, and

treating the final coagulated water with a separation membrane of which the surface zeta potential is less than 0 mV, to obtain treated water.

[0013a] In an aspect, there is provided a water treatment method comprising

dosing a cationic coagulant to raw water to obtain primary coagulated water,

using the primary coagulated water as it is as final

coagulated water when the zeta potential of the primary coagulated water is less than 0 mV, or using final coagulated water obtained by dosing an anionic substance so that the zeta potential is less than 0 mV when the zeta potential of the primary coagulated water is 0 mV or more, and

treating the final coagulated water with a separation membrane of which the surface zeta potential is less than 0 mV, and which serves as a microfiltration membrane or an ultrafiltration membrane, to obtain treated water, and desalinating the water treated with the separation membrane with a semipermeable membrane having a surface zeta potential less than 0 mV.

[0014]

As a preferred embodiment, the present disclosure includes the following embodiments.

(2) The water treatment method, wherein a concentration Cop1 of a cationic coagulant to be dosed in the primary coagulated

water is set to a value that is larger than Cmin and smaller than Cmax, Cmin and Cmax which are each determined and defined as follows:

Cmin: Concentration of a cationic coagulant in the primary coagulated water capable of obtaining the maximum coagulation effect when the water quality index of raw water is the lowest; and

Cmax: Concentration of a cationic coagulant in the primary coagulated water capable of obtaining the maximum coagulation effect when the water quality index of raw water is the highest.

(3) The water treatment method, wherein the water quality index of raw water is at least one selected from the group consisting of a turbidity, a fine particle concentration, a total suspended solid (TSS) concentration, a total organic carbon (TOC) concentration, a dissolved organic carbon (DOC) concentration, a chemical oxygen demand (COD), a biological oxygen demand (BOD), and a ultraviolet ray adsorption (UVA) amount.

(4) The water treatment method according to any of the embodiments, wherein an dosing concentration Cop2 of an anionic substance

is determined in advance so that the zeta potential is to be less than 0 mV by the dosing to water in which the cationic coagulant is dosed to pure water so that the concentration is to be a difference (Cmax - Cmin), and the anionic substance is

dosed to the primary coagulated water so that the concentration in the primary coagulated water is Cop2.

(5) The water treatment method according to any of the embodiments, wherein the cationic coagulant is an inorganic coagulant and the anionic substance is an organic coagulant.

(6) The water treatment method according to any of the embodiments, wherein the water treated with the separation membrane is further desalinated with a semipermeable membrane having a surface zeta potential less than 0 mV.

EFFECTS

[0015]

According to a water treatment method of the present disclosure, when impurities in water such as seawater and river water are coagulated, separated, and removed with a separation membrane, the performance of the separation membrane can be maintained and clarified water with high quality can be stably obtained.

[0016]

In particular, even when the water quality of raw water varies, clarified water with high water quality can be stably obtained at low cost by properly adjusting the dosing concentration of a cationic coagulant and an anionic substance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a flow diagram exhibiting an example of a water

treatment device using a water treatment method as defined above.

Fig. 2 is a flow diagram exhibiting an example of a desalinated water treatment device using the water treatment method of the present invention.

EMBODIMENTS OF THE INVENTION

[0018]

Hereinafter, embodiments of the present invention will be described with reference to the drawings, but the present invention is not limited to the embodiments.

[0019]

Fig. 1 is a flow diagram exhibiting an example of a water treatment device to which the present invention can be applied.

[0020]

In Fig. 1, raw water a is stored in a raw water tank 1, and taken by an intake pump 2, a cationic coagulant having positive charges is dosed by a cationic coagulant dosing unit 3, and flocs are formed and grown by a first stirrer 5 in a first mixing tank 4 to obtain primary coagulated water b. Next, when the zeta potential of the primary coagulated water b is 0 mV or more, an anionic substance having negative charges is dosed by an anionic substance dosing unit 6, the cationic coagulant is neutralized by a second stirrer 8 in a second mixing tank 7, and the coagulated flocs are further grown to obtain final coagulated water c. In contrast, when the zeta potential of

CLAIMS

1. A water treatment method comprising

dosing a cationic coagulant to raw water to obtain primary coagulated water,

using the primary coagulated water as it is as final coagulated water when the zeta potential of the primary coagulated water is less than 0 mV, or using final coagulated water obtained by dosing an anionic substance so that the zeta potential is less than 0 mV when the zeta potential of the primary coagulated water is 0 mV or more, and

treating the final coagulated water with a separation membrane of which the surface zeta potential is less than 0 mV, and which serves as a microfiltration membrane or an ultrafiltration membrane, to obtain treated water, and desalinating the water treated with the separation membrane with a semipermeable membrane having a surface zeta potential less than 0 mV.

2. The water treatment method according to claim 1, wherein a concentration Cop1 of the cationic coagulant to be dosed in the primary coagulated water is set to a value that is larger than Cmin and smaller than Cmax, Cmin and Cmax which are each determined and defined as follows:
Cmin: Concentration of a cationic coagulant in the primary coagulated water capable of obtaining the maximum coagulation effect when the water quality index of raw water is the lowest; and

Cmax: Concentration of a cationic coagulant in the primary coagulated water capable of obtaining the maximum coagulation effect when the water quality index of raw water is the highest.

3. The water treatment method according to claim 2, wherein a water quality index of raw water is at least one selected from the group consisting of a turbidity, a fine particle concentration, a total suspended solid (TSS) concentration, a total organic carbon (TOC) concentration, a dissolved organic carbon (DOC) concentration, a chemical oxygen demand (COD), a biological oxygen demand (BOD), and a ultraviolet ray adsorption (UVA) amount.

4. The water treatment method according to any of claims 1 to 3, wherein an dosing concentration Cop2 of an anionic substance is determined in advance so that the zeta potential is to be less than 0 mV by dosing to water in which the cationic coagulant is dosed to pure water so that the concentration is to be a difference (Cmax - Cmin), and the anionic substance is dosed to the primary coagulated water so that the concentration in the primary coagulated water is Cop2.

5. The water treatment method according to any of claims 1 to 4, wherein the cationic coagulant is an inorganic coagulant and the anionic substance is an organic coagulant.

6. The water treatment method according to any of claims 1 to 5 comprising the step of stopping the treatment with

the separation membrane during the method to perform counter-pressure washing and air washing to the separation membrane.